

Review



Effects of paternal alcoholism on the psycho-behavioural outcomes of the offspring: a systematic review and meta-analysis

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Abstract

Documented literature includes mixed interpretations of the impact of paternal alcoholism on psycho-behavioral well-being of offspring. A systematic review and a meta-analysis would facilitate the accurate establishment of this association. This review was done to evaluate the effects of paternal alcohol use disorder (AUD) or problem drinking (PD) on the psycho-behavioral well-being of the offspring at different stages of their lifecycle. This PROSPERO-registered review (CRD42018114754) was conducted by reviewing literature in MEDLINE, EMBASE and PsycINFO databases. A total of 29 articles out of 18113 were selected for data extraction after three selection rounds. Eleven were included in the meta-analyses for three numerically and one categorically assessed outcomes on internalizing behaviour, externalizing behaviour and anxiety. Heterogeneity, risk of bias and the certainty-of-evidence were assessed. Sensitivity analysis was done. Rev-Man (version 5.3) software and “GRADEproGDT” online applications were used. A narrative review was done with studies and sub-groups not included in the meta-analysis under five identified themes: depression and mood disorders, self-perceived mental health problems and personality, aggression, attention deficit hyperactive disorder and other problems. With meta-analyses, all outcomes demonstrated significant standardized mean differences or odds ratio with higher unfavourable values in the exposed group. 'Low' level GRADE certainty was assigned. In sensitivity analysis, associations of similar directions were observed. Narrative review reflected other negative psycho-behavioral consequences of children associated with paternal alcoholism, falling under the five identified themes. In conclusion, robust findings of the meta-analyses and narrative review suggest that paternal AUD and PD are associated with unfavourable psycho-behavioural consequences among their offspring at many stages of the life cycle.

Keywords: paternal alcoholism, alcohol use disorder, problem drinking, effects of alcoholism, externalizing disorders, internalizing disorders, anxiety, depression, meta-analysis.

Introduction

It is estimated that around 43% of the people 15 years and above were current drinkers in 2016, with a considerable variation worldwide. In addition, nearly a quarter of alcohol consumption in the world and more than half in South-East Asia are unrecorded (1). Alcohol use is within the top 10 risk factors of death and disability adjusted life years (2). Out of the substance use disorders, alcohol use has been the most common (3). In the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), a single entity called 'alcohol use disorder' (AUD) has been suggested encompassing previous entities of 'alcohol-abuse' and 'alcohol dependence' (4). Those who consume alcohol in unhealthy manner but do not fit into the category of AUD are called 'problem drinkers' (PD) (5). Strategies to prevent alcoholism have been emphasized globally owing to the recent epidemic of chronic non-communicable diseases (NCDs) to which excess alcohol consumption contributes heavily. The achievement of Sustainable Development Goals is regarded as only possible if interventions are implemented to address the alcohol burden (1, 3).

In addition to its direct health-related effects, alcoholism has legal, economic and social implications. Having an alcoholic in the household is assumed to influence the children in diverse ways. In a study done among Korean students, it was revealed that childhood exposure to an alcoholic or substance abuser has a 2.4 times greater likelihood of being diagnosed with 'definite depression' and 2.11 times greater chance of potentially developing alcoholism (6). In a Chilean study, it was revealed that the consumption of alcohol in the household leads to an increased probability in the child witnessing physical violence and verbal violence as well as economic problems resulting in the inability of families to provide optimum care for the child (7). A Norwegian study reported alcohol abuse by parents as an independent risk factor for school related attention and conduct problems (8). Higher prevalence of corporal punishment was reported among the heavy alcoholics towards three-year old children in United States (9). Additionally, parental drinking patterns influence the intake of alcohol by their children,

which in turn could lead to a vicious cycle of negative consequences (10).

Though many of the studies have explored 'parental alcoholism', in the majority of families, AUD and PD are more likely to be associated with the father than with mother in many parts of the world (11-12). The specific influence of paternal drinking on children has been explored to a lesser extent in literature. Many of this limited literature in the form of individual studies, point towards negative consequences of paternal alcoholism on the psycho-social wellbeing of their children at different stages of the life cycle (13-16). However, contrasting evidence is being reported in studies done on parents including fathers diluting the robustness of conclusions on these unfavourable associations. Some studies have demonstrated that there is no difference between the emotional and behavioural problems of children in relation to the alcohol intake status of their parents (11). Similarly, some literature has demonstrated significant effects of mothers' alcohol intake but not that of fathers (17). Furthermore, some studies have documented that, in general, children of parents with alcoholism could 'manage quite well' (17). In many of the studies focusing on these associations, several limitations including the small sample sizes have been highlighted. Hence, a systematically reviewed literature with meta-analyses could help in correctly establishing the effects of paternal alcoholism on the psycho-behavioural well-being of offspring.

Measurements in relation to behavioural disorders are one element of the assessment of psych-behavioral wellbeing. These disorders are conventionally classified as internal and external. Externalizing behaviours of children include lack of compliance with social norms, lower emotional control and associated interpersonal aggressiveness (18). In contrast, internalizing disorders are directed inwards and reflect the child's psychological and emotional state (19-20). These encompass a diverse group of conditions which include depression, withdrawal, and anxiety, as well as feelings of inferiority, self-consciousness, shyness, hypersensitivity, and somatic complaints (19-20). There is an overlap between externalizing behaviours and internalizing disorders, and therefore the term 'psycho-behavioural outcomes' would be

more appropriate in representing a comprehensive scope of the dynamics and interactions related to these.

This systematic review includes four meta-analyses done on the effects of paternal alcoholism in the forms of AUD or PD, on psycho-behavioural outcomes of offspring. Additionally, it includes a narrative review covering a broader range of outcomes in the selected studies or their sub-groups not included in the meta-analyses.

Methods

Protocol and registration

The review was done according to the PRISMA (i.e., Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines (21). Registration of the review was done in the International prospective register of systematic reviews registration (PROSPERO-CRD42018114754).

Eligibility criteria

The PICO sequence of the research question (22) was whether 'paternal alcoholism in the form of AUD or PD, incurs effects compared to its absence, on the psychological and behavioural outcomes of offspring'. The selection criteria of the studies included studies having a quantifiable effect measure related to psychological or behavioral well-being of offspring and including a paternal specific analysis. Psychological or behavioural well-being outcomes of interest included depression, anxiety, internalizing behavioral, externalizing behaviour, self-perceived mental well-being, personality, aggression, attention deficit hyperactive disorder (ADHD) and non-compliance. Outcomes on suicidal ideation, parental attachment, alcohol-use of children, and education attainment of offspring were outside the scope of this review and were excluded. Studies with the exposure status being specifically limited to the pre-natal period and publications only in the form of conference-abstracts were also excluded.

Search strategy

The literature search was done in MEDLINE, EMBASE and PsycINFO databases. Search strategies were finalized with the inputs of a research librarian (supplementary material of the search strategies). The period covered in the search was from 1 January 1998 to July 2020. Additionally, the reference lists of selected articles were searched for potential articles. When the data required for meta-analysis were not available in the manuscript, attempts were made to contact the respective corresponding authors through emails. After compiling the initial draft of the manuscript, additional searches were done for any new articles up to the end of September 2020.

Selection of studies

Three rounds of selections were done. In the first round, duplicated articles and those not consistent with the general objective of the review were excluded. Abstracts were reviewed in the first round. Full articles were reviewed from the second round onwards. In the second round, articles were reviewed for the outcome and the study design. Mere qualitative manuscripts and studies with non-matching outcomes for the scope of the review were excluded. In the third round of selection, the characteristics of the exposed/non-exposed groups were reviewed. Manuscripts with discrepancies of the defined exposure which did not include a paternal specific analysis were excluded. Two reviewers independently did the study selection, with the involvement of a third in discrepancies. The flow diagram of the selection process is illustrated in Figure 1.

Data extraction

Data extraction was done using a pre-designed template. When several follow-up measurements were available in a single selected study for meta-analysis, the last wave of data collection was selected for the extraction.

Estimation of bias

A risk of bias table for the selected studies for the meta-analyses was prepared having referred the necessary recommendations for observational studies (23). Bias assessments were independently done by two reviewers with discrepancies being attended by a third. Subsequently, Funnel plots were used in the assessment of publication bias (24). Mean differences was used for the Funnel plots as SMDs are known to produce false positive results (25).

Meta-analysis and narrative synthesis

Clinical and methodological heterogeneity assessment was done and the potential studies/subgroups which could be included in meta-analyses were determined (26). In determining the clinical heterogeneity, the assessed outcomes, tools used in these assessments and scoring methods were considered. For the methodological heterogeneity assessments, study designs and risk of bias findings were considered. The assessment for statistical heterogeneity of the selected studies was done using Chi-squared and I-squared tests for all the meta-analyses (24, 27). The potential cut-offs of the I-squared test for heterogeneity and for the p value of Chi-squared test considered were 50% and 0.1, respectively (24, 28).

Following the heterogeneity assessments, Review Manager (version 5.3) application was used for the meta-analyses (29) with pooling done by Mantel-Haenszel Method. Initially, fixed model assumptions were followed and for assessing the robustness of the findings, sensitivity analysis was done by re-performing the meta-analysis with random-method assumption (30-31). In addition, sub-group analysis was done according to the age groups of the offspring, where relevant. Standardized mean difference (SMD) with its confidence interval (CI) was used as the effect measure for continuous measurements. Odds ratio (OR) was used for the categorical variables. When studies have provided gender specific effect measures without a combined measure, they were separately included as sub-groups in the meta-analysis. Summary of the findings table was synthesized for the meta-analyses (32). GRADE criteria were used in assessing the certainty of evidence. “GRADEproGDT” online application was used in this regard (23, 33-34). When the studies that met eligibility criteria for the review were not selected for the meta-analyses, those were included only in the narrative synthesis (35-36). This happened either due to the unavailability of complete data needed for the meta-analysis or detection of heterogeneity (including when the exposed group cannot be differentiated as AUD or PD).

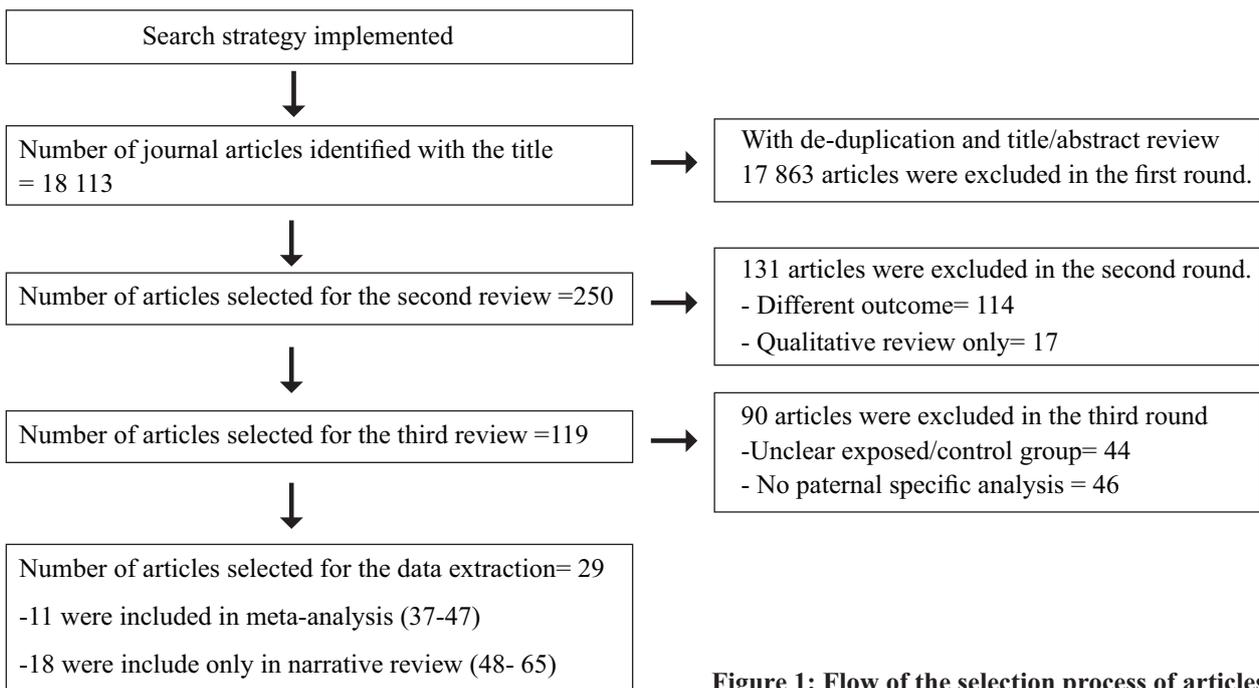


Figure 1: Flow of the selection process of articles

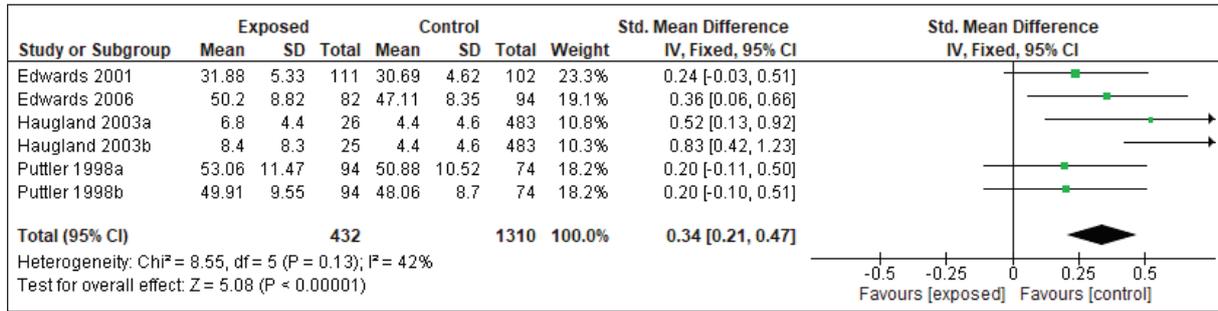


Figure 2a: Internalizing behaviour

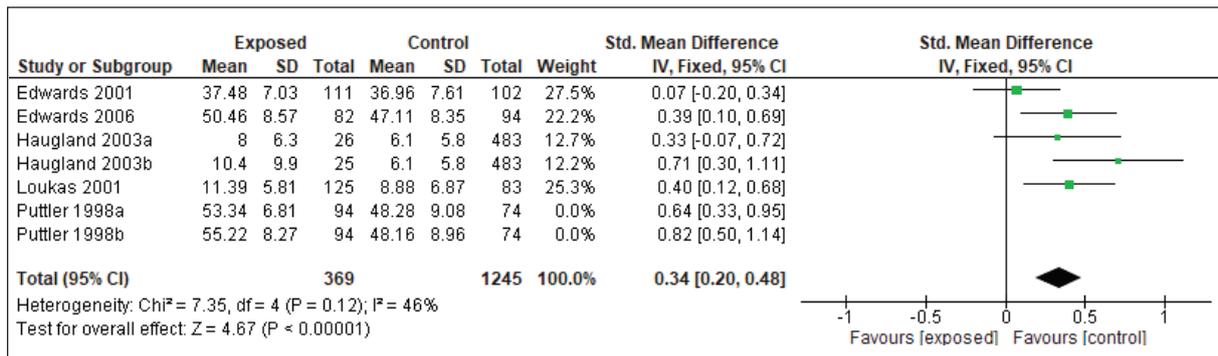


Figure 2b: Externalizing behaviour

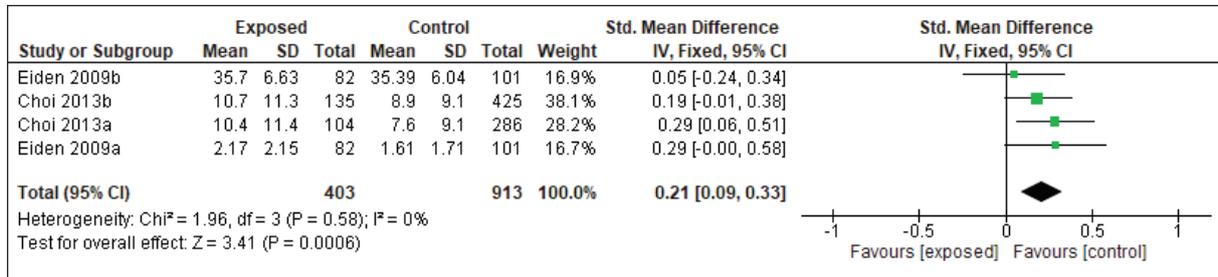


Figure 2c: Anxiety as a numerical variable

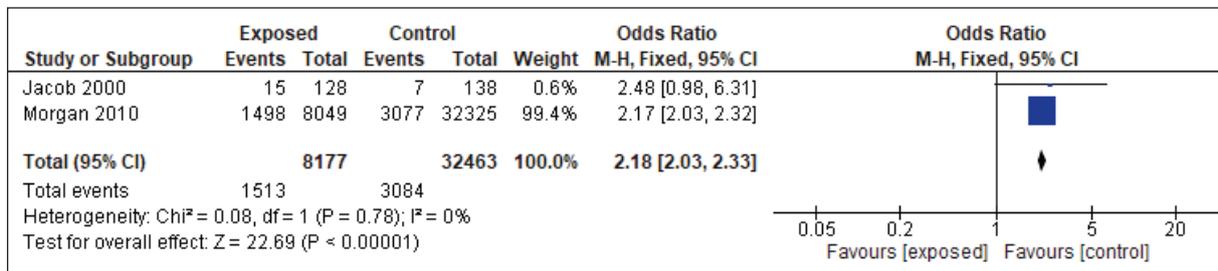


Figure 2d: Anxiety as a categorical variable

Figure 2: Forest plots for the outcomes of meta-analyses

Results

At the end of the three rounds of selection, 11 studies were selected for meta-analyses (37-47). Table 1 summarizes their characteristics. The articles selected only for the narrative review have been summarized in Table 2 (48-65). All these articles were excluded from the meta-analysis due to clinical heterogeneity.

The risk of bias estimates of the selected articles used for the meta-analyses, have been summarized in Table 3. To impart an impartial judgment, for all studies, the failure of confounding control was judged as with 'unclear risk'. As all the studies used validated instruments, for 'flawed measurements', the bias was estimated to be of low risk. The risk of bias estimates of the studies only included in the narrative review are also shown in Table 3.

As shown in Table 4, for the numerical outcomes of internalizing behaviours, externalizing behaviours and anxiety, significant SMDs were noted. The unfavourable measurements were higher for the exposed (i.e., paternal alcoholism) group. A significantly higher relative effect (OR=2.18; 95% CI=2.03, 2.33) was noted for the exposed group (i.e., with paternal alcoholism) for the occurrence of childhood anxiety among children when analysed as a categorical outcome (Table 5).

Even though the meta-analysis of three studies (37, 41-42) yielded a pooled OR of 1.68 (95% CI=1.28, 2.2) for depression when assessed as a categorical outcome, statistical heterogeneity was noted ($I^2=74%$). In addition, the categorization criteria of paternal alcoholism of one study could not be differentiated as AUD or PD (37). Hence, those findings were described in the narrative review section below. Figures 2A-2D show the Forest plots of the meta-analyses.

All Funnel plots reflected that there is no evidence of any major publication bias. The sensitivity analysis is summarized in Table 6. The observed effect measures remained statistically significant demonstrating the robustness of the findings. The narrative synthesis

based on the studies or sub-groups which were not included in the meta-analyses is described below.

Depression and mood disorders

Associations of paternal alcoholism and adult offspring were described in four studies for depression and in one for mood disorders. All of these were reported from United States and Netherlands. In the United States (50), when fathers were with active problem drinking, the college students were found to have 1.56 times greater likelihood of having depressive symptoms (95% CI=1.24, 1.96). Even when stratified for gender, significantly higher likelihoods were observed for males (OR=1.75; 95% CI=1.14, 2.68) and females (OR=1.49; 95% CI=1.13, 1.96) (40). In one study, the RDC depression percentages were 35.9% and 33.3% respectively for the exposed and control groups among the adult offspring (42). Following structural equation modelling, done with data collected among undergraduate students, it was revealed that paternal alcoholism had a total effect on depressive symptoms ($\beta=0.118$; 95% CI=0.006, 0.23; $p=0.039$) (59). In a study done in California, a slight increase (21.3% to 18%) of depression was noted among females, whereas for males, an opposite association (16.2% versus 19.6%) was noted in adult offspring (41). In a study done in Netherland among Dutch adults of 18-64 years, mood disorders were higher among the group with problem drinking of fathers (18.6% to 7.0%; $p<0.001$) (51). In the same study, the exposed group was associated with 1.74 times higher risk of getting mood disorders among the offspring (51).

Four studies from India, Korea and United States have assessed these associations on school/high-school-aged or teenage offspring. A North Indian study revealed a significant association between the alcohol use of the father and depression in the school children (43.8% of paternal drinkers in the children with depression compared to 24.6% among the non-depressed group) (37). Among high school children, in Korea, father's drinking problems were associated with a higher depression score in both genders ($p=0.005$ for males and $p<0.001$ for females) (47). A non-significant independent association ($\beta=-0.03$;

$p > 0.05$) with paternal alcoholism and depression was found by Kelley et al (2010) among university students (58). One study showed that paternal alcoholism is associated with depression among 17-year-old offspring (OR=1.76; 95% CI=1.17, 2.67) but not at 14 years (OR=0.68; 95% CI=0.35, 1.35) (62).

Self-perceived mental health problems and personality

Two studies from the United States have reported on self-perceived mental health problems and on personality. In a longitudinal study done in the United States, the SF-12 Mental Health Index values were found to be worse in children of problem drinking fathers even at age 40 compared to those of non-alcoholic fathers (31.17 versus 28.99; $p < 0.01$) (49). In another study, children of alcoholic fathers reported less favourable outcomes compared to children with non-alcoholic fathers for the five domains; extraversion ($p < 0.05$), neuroticism ($p < 0.01$), agreeableness ($p < 0.01$), conscientiousness ($p < 0.05$) and openness to experience ($p < 0.05$) assessed by NEO-Personality Inventory (42).

Aggression

Five studies have reported on this association with one study being done below 5 years and the others among school-aged adolescents. Edwards et al (2006b) conducted a study to explore aggressive behaviour of children who experienced paternal alcoholism. It was found that by 48 months, 22% of children were in the clinical range for aggression in the father-alcoholic group compared to 5.4% in the non-alcohol group (53). As concluded by Grekin and others (2005) by a two-step hierarchical regression, paternal alcoholism is a predictor of both violent and non-violent delinquency at age 15 ($p < 0.05$) (56). The study by Finan et al (2015) showed that paternal problem drinking was a direct predictor for aggressive behaviour for boys ($\beta = -0.37$; $p < 0.05$). For both girls and boys, indirect associations of paternal alcoholism (i.e., by affecting family cohesion) were demonstrated (54). Malone et al (2002), showed the positive association of paternal alcoholism with 'any

disruptive behaviours' at 11 years (OR=1.71; 95% CI=1.23, 2.39) and 17 years (OR=2.11; 95% CI=1.54, 2.9) (62). Auto-aggressiveness of school students was not found to be associated with paternal alcoholism ($\beta = 0.033$; $p = 0.48$) in a study done in Croatia (65).

ADHD

Four studies have reported on ADHD among persons with average age around 10-20 years, from Vietnam, Croatia and United States. In a twin study done by Knopik et al (2005), paternal alcohol dependence was significantly associated with ADHD (OR=2.11; 95% CI=1.39, 3.22) (61). With further studies, this association is assumed to be influenced by indirect pathways (60). The association between paternal alcoholism and ADHD at 17 years (OR=2.19; 95% CI=1.23, 3.92) but not at 11 years (OR=1.64; 95% CI=0.97, 2.75) was shown in a study done in Minnesota, United States (62). In another study, the standardized incidence ratio of ADHD among children who experienced paternal alcoholism was 2.15 (95% CI=2.11, 2.2) (64).

Other problems

Seven studies have reported findings related to this domain. The outcome measurements of these have been done covering many stages of the life cycle. In one study, sons of fathers with alcohol-problems demonstrated higher values for non-compliance on four measures of compliance (i.e., committed compliance, passive non-compliance, resistance and defiance) than the children with paternal alcoholism within first two years of life ($p < 0.05$) (52). In another study (57), indirect effect of paternal alcoholism on internalizing and externalizing problems was evaluated with bootstrapping. It was revealed that the associations were significant at $p < 0.001$ level. The data collections were done while the children were in kindergarten and in the following two years. Adkison et al (2013) have shown with structural equation modeling that paternal alcoholism is associated with lower self-regulatory strategies of the child at grade 6 ($p < 0.05$) (48).

In one study, it was revealed that paternal alcoholism alone is not significantly associated with psychiatric symptoms among twins between 8-17 years. However, when analysed in gender-specific models, among males it was associated with a 0.27 increase ($p=0.002$) and with a non-significant increase of 0.04 in females ($p=0.38$) (55). In a 15-year follow-up study from birth, it concluded with survival analysis with log-rank tests that, for both girls and boys, paternal alcohol use (either less-severe or severe) was associated with a higher likelihood of mental and behavioural disorders among children ($p<0.0001$) (63).

Among Dutch adults (18-64 years), having a father with problem drinking has found to be a significant predictor for getting one or more psychiatric disorders in 12-months ($OR=1.47$; $p<0.05$) or over the lifetime ($OR=2.0$; $p<0.05$) (51). Similarly, according to Balsa et al (2009), a higher proportion (10.6%) was ever-diagnosed with mental health problems when father was with problem drinking compared to the no-problem drinking parent group (6.2%). Similarly, 7.1% of the exposed group had mental health problems diagnosed in the previous 12 months compared to 3.7% of the no-problem drinking category (49).

Discussion

This is the first systematic review with meta-analyses that evaluate the effects of paternal alcoholism covering a comprehensive scope of psycho-behavioral outcomes of children. Unlike pre-existing literature which has been confined to a limited set of outcomes, since psychological well-being and behavioral dynamics are inter-related, this review provides a better understanding of the associations between paternal alcoholism. The findings revealed that the influence of paternal alcoholism extends throughout the life cycle of their offspring. Negative consequences generated by the said exposure include associations with internalizing behaviours, externalizing behaviours, anxiety, depression, personality disorders, impairment of self-perceived mental health, aggression, ADHD and non-compliance in children.

All the four meta-analyses which were done have shown significant negative outcomes in relation to internalizing behaviours, externalizing behaviours and anxiety of offspring. The specific criteria mentioned under the methodological were rigorously considered in deciding the suitability of the studies/sub-groups included in the meta-analysis. It was decided that no study which is potentially eligible for the meta-analysis, was needed to be removed from it owing to the overall risk of bias. The robustness of these findings was verified with the unchanged findings following the sensitivity analysis. Both internalizing and externalizing behaviours of children lead to negative consequences (18-20). Some of these could be hidden and hard to detect. As an example, depression is associated with a high economic burden and is often undiagnosed (66). Anxiety is also found in high prevalence in the community, often undiagnosed and commonly associated with comorbidities (67). These disorders also influence the social competence of those affected (20). In addition to the outcomes in meta-analyses, the outcomes described in the narrative review highlight the negative influence of paternal alcoholism on the psycho-behavioral outcomes of offspring.

The study populations in the review include many stages of the life cycle including categories of under 5-years, school-age, adolescents, university students and adult-offspring. Subgroup analyses have been done in the present review where relevant. Negative implications of paternal alcoholism were observed for all these categories. This further strengthens the robustness of the findings and implies that the impact of paternal alcoholism extends throughout the life cycle of the children. In literature, even in instances that do not show a direct significant association between psychiatric issues and paternal alcoholism, positive associations have been noted when the exposed group was with associated comorbidities such as paternal depression (55). It is well-noted that the paternal alcoholism is associated with conditions such as reduced quality of marital relationships and behaviours which may make the father prone to depressive symptoms (68). These indirect pathways further complement the finding that paternal

Table 1: Characteristics of the studies selected for meta-analysis

Study	Setting	Population/s	Exposure measurements	Selected outcomes measurements	Effect measure
Choi, 2013 (47)	Chungam province, Korea	950 students in an academic high school	By Father-Short Michigan Alcoholism Screening Test completed by children	<ul style="list-style-type: none"> Depression with Beck's Depression Inventory Anxiety with Beck's Anxiety Inventory Measurements taken at a mean age of 16.5 years 	MD
Edwards, 2001 (45)	New York, United states	A cohort of 213 families in a longitudinal study	Family History Research Diagnostic Criteria (RDC) for alcoholism by the partner as well as by the responses of the father for University of Michigan Composite Diagnostic Index (UM-CIDI) and with DSM-IV criteria	<ul style="list-style-type: none"> 2-3-year version of the Child Behavior Checklist (CBCL) Selected measurements done when the child was 18 months 	MD
Edwards, 2006 (46)	New York, United states	A cohort of 191 families in a longitudinal study. Analysis was done for 176 families	RDC, UM-CIDI and DSM IV criteria	<ul style="list-style-type: none"> CBCL Selected measurements done when the child was three years 	MD
Eiden, 2009 (44)	New York, United states	112 children with parent alcoholic group and 101 without alcoholic group	RDC, UM-CIDI and DSM IV criteria	<ul style="list-style-type: none"> Relevant subscales of CBCL Revised Child Manifest Anxiety Scale Child Depression Inventory Measurements done at Grade 4 	MD
Haugland, 2003 (43)	Norway	37 families with paternal alcohol problems and 1170 general population sample	Cahalan's questionnaire	<ul style="list-style-type: none"> Child Behavior Checklist Measurements done between 7-11 years 	MD

Jacob, 1999 (41)	California, United States	297 offspring of families those had participated in an assessment 5 years back	SADS-L questionnaire, RDC, DSM IV	<ul style="list-style-type: none"> RDC diagnosis Mean age at outcome assessment was 23.8 years 	OR
Jacob, 2000 (42)	California, United States	393 adult offspring of families having participated in an assessment 10 years back	RDC, DSM IV	<ul style="list-style-type: none"> NEO-Personality Inventory RDC for depressive disorder and anxiety disorder Social Adjustment Scale-Self Report Mean age at outcome measurement was 27.1 years 	OR
Loukas, 2001 (40)	United States	Male children from 125 families with ad 83 families without an alcoholic father	Short Michigan Alcoholism Screening Test, Diagnostic Interview Schedule, Drinking and Drug History Interview	<ul style="list-style-type: none"> Child Behavior Checklist Measurements done at 6-8 years 	MD
Morgan, 2010 (39)	Data from National Epidemiological data from United States	43093 non-institutionalized residents. Sample used for analysis consisted of 40374	DSM IV version of Alcohol Use Disorder and Associated Disabilities Interview Schedule	<ul style="list-style-type: none"> -DSM IV version of Alcohol Use Disorder and Associated Disabilities Interview Schedule Respondents were 18 years or over 	QR
Purtler, 1998 (38)	Michigan, United States	212 families of the MSU-UM Longitudinal study	Diagnosis made by trained clinicians using DSM-IV criteria	<ul style="list-style-type: none"> Child Behavior Checklist-Parent Version (CBCL) Mean age of respondents was 5.63 years 	MD
Singh, 2017 (37)	542 Schools in Chandigarh, India	School going adolescents (13-18 years)	Using a structured questionnaire based on literature review	<ul style="list-style-type: none"> Patient Health Questionnaire-9 Respondents were between 13-18 years 	QR

Table 2: Characteristics of the studies selected for narrative review

Study	Setting	Population/s	Exposure measurements	Outcome measurements
Adkison, 2013 (48)	United States	197 families with 12-month-old infants at recruitment	RDC, UM-CIDI and DSM IV criteria	<ul style="list-style-type: none"> • Stroop Color and Word Test • Tower of London task • Stop-Signal Reaction Time • Measurements done in grades 4 and 6
Balsa, 2009 (49)	United States	12686 youths between years 14 and 22 in 1979, Re-assessments were done until 1994	Questionnaire of National Longitudinal Survey of Youth, 1979	<ul style="list-style-type: none"> • SF-12 Mental Health Index • Diagnosis of a mental health condition in last 12 months (Balsa et al., 2009) • Diagnosis of a mental health condition ever • Measurements done at 40 years
Chen, 2005 (50)	United States	A nationally representative sample of college students of 27430	DSM-IV approximate criteria	<ul style="list-style-type: none"> • Mental Health subscale of SF-36
Cuijpers, 1999 (51)	Netherlands	A random sample of Dutch population (N=7147) with data from “Netherlands Mental Health Survey and Incidence Study”	-Respondents' self-reports	<ul style="list-style-type: none"> • Respondents' self-reports
Edwards, 2006b (53)	United States	A sample of 226 families selected from birth records for Erie County	RDC, UM-CIDI and DSM IV criteria	<ul style="list-style-type: none"> • Aggression subscale of the CBCL • Measurements were done at child age of 18, 24, 36 and 48 months
Eiden, 2001 (52)	United States	215 families with 12-month-old children	RDC, UM-CIDI and DSM IV criteria	<ul style="list-style-type: none"> • According to guidelines of Kochanska and Aksham (1995) • Measurements done at 18 and 24 months
Finan, 2015 (54)	United States	Adolescents from 14-19 years and their parents	Short Michigan Alcoholism Screening Test	<ul style="list-style-type: none"> • Child Behaviour Checklist • Mean age of the participants was 16.15 years

Finan, 2015 (55)	United States	850 twin families	DSM-III-R criteria	<ul style="list-style-type: none"> Child and Adolescent Psychiatric Assessment-Children's Version (CAPA-C) Ages of twins was between of 8-17 years
Grekin, 2005 (56)	Brisbane, Australia	816 families with children born between 1981-1984 in a Mother's Hospital	Using structured Clinical Interview for the DSM-IV	<ul style="list-style-type: none"> Self-report items from National Youth Survey The mean age of the sample was 15 years and two months
Keller, 2008 (57)	United States	235 families from a midsize and large city	Parental Alcohol Experiences Scale	<ul style="list-style-type: none"> Internalizing and externalizing subscales of CBSL Data collection done at baseline, 1 year later and 2 years later
Kelley, 2010 (58)	South-eastern United States	627 students attending a university	Children of Alcoholics Screening test	<ul style="list-style-type: none"> Depression-Dejection subscale of the Profile of Mood States questionnaire
Kelley, 2011 (59)	United States	436 undergraduate university students in South-eastern Virginia	Children of Alcoholics Screening Test	<ul style="list-style-type: none"> Profile of Mood States questionnaire The average age was 21.93 years
Knopik, 2005 (61)	United States	1936 adolescent female twin pairs born during 1975-1985	DSM-IV incorporated Semi-Structured Assessment of the Genetics of Alcoholism	<ul style="list-style-type: none"> Items derived from the Diagnostic Interview for Children and Adolescents Average age was 14.4 years
Knopik, 2009 (60)	Vietnam	727 twin fathers, and 1116 children	DSM-IV incorporated Semi-Structured Assessment of the Genetics of Alcoholism	<ul style="list-style-type: none"> Items derived from the Diagnostic Interview for Children and Adolescents Average child age was 19.1 years
Malone, 2002 (62)	Minnesota, United States	2426 twin subjects	Using substance abuse module	<ul style="list-style-type: none"> Revised Diagnostic Interview for Children and Adolescents Twins were 11 or 17 years of age
Raitasala, 2018 (63)	Finland	57377 children born in 1997 and their parents	Using ICD-10 criteria	<ul style="list-style-type: none"> Using ICD-10 criteria Children were followed up until the end of 2012
Tripkovic, 2013 (65)	Croatia	Sample of 701 school students from 14-19 years	Using a specially designed questionnaire	<ul style="list-style-type: none"> Using the Report on Youth Aged 11-18 and the Scale of Auto-destructiveness
Sundquist, 2014 (64)	Sweden	49348 individuals with ADHD	ICD-9 and ICD-10 guidelines	<ul style="list-style-type: none"> ICD-9 and ICD-10 codes 46.3% were between 10-19 years

Table 3: Risk of bias estimates of the studies included in meta-analysis and narrative review

Study	Failures in eligibility criteria	Flawed measurements	Failures in confounding control	Incomplete follow up
In meta-analysis				
Choi, 2013 (47)	Low	Low	Unclear	Low
Edwards, 2001 (45)	Low	Low	Unclear	Unclear
Edwards, 2006 (0)	Low	Low	Unclear	Unclear
Eiden, 2009 (44)	Low	Low	Unclear	Unclear
Haughland, 2003 (43)	Unclear	Low	Unclear	Unclear
Jacob, 1999 (41)	Low	Low	Unclear	Unclear
Jacob, 2000 (42)	Low	Low	Unclear	Unclear
Loukas, 2001 (40)	Low	Low	Unclear	Low
Morgan, 2010 (39)	Low	Low	Unclear	Low
Puttler, 1998 (38)	Low	Low	Unclear	Low
Singh, 2017 (37)	Unclear	Low	Unclear	Low
In narrative review				
Adkinson, 2013 (48)	Low	Low	Unclear	Low
Balsa, 2009 (49)	Low	Low	Unclear	Unclear
Chen, 2005 (50)	Low	Low	Unclear	Unclear
Cujipers, 1999 (51)	Low	Unclear	Unclear	Unclear
Edwards, 2006b (53)	Low	Low	Unclear	Unclear
Eiden, 2001 (52)	Low	Low	Unclear	Unclear
Finan, 2015 (54)	Low	Low	Unclear	Unclear
Foley, 2001 (55)	Low	Low	Unclear	Low
Grekin, 2005 (56)	Low	Low	Unclear	Low
Keller, 2008 (57)	Low	Low	Unclear	Low
Kelley, 2010 (58)	Low	Low	Unclear	Unclear
Kelley, 2011 (59)	Unclear	Low	Unclear	Unclear
Knopik, 2009 (60)	Low	Low	Unclear	Unclear
Knopik, 2005 (61)	Low	Low	Unclear	Low
Malone, 2002 (62)	Low	Low	Unclear	Low
Raitasalo, 2018 (63)	Low	Low	Unclear	Low
Sundquist, 2014 (64)	Low	Low	Unclear	Unclear
Tripkovic, 2013 (65)	Unclear	Low	Unclear	Unclear

Table 4: Summary of the finding of the meta-analyses of numerical outcomes

Effect of paternal alcoholism on the psycho-social well-being of children					
Outcome	Anticipated absolute effect		No of participants (studies)	Comments	Quality of evidence/ GRADE
	Risk of comparison group	Risk of the children with alcoholic fathers			
Internalizing behaviour	N/A	SMD 0.34 higher (0.21 higher to 0.47 higher)	1742 (4 studies/ 6 sub-groups) (38, 43, 44, 46)	Exposed group had significantly higher means in three sub-groups (43, 46) and higher non-significant means in three sub-groups (38, 45)	Low ^c
Externalizing behaviour	N/A	SMD 0.34 higher (0.20 higher to 0.48 higher)	1614 (5 studies/ 7 sub-groups) (38, 40, 43, 45, 50)	Exposed group had statistically significant higher means in three sub-groups (40, 43, 46) and higher non-significant means in two sub-groups (43,45). One study was excluded from meta-analysis considering statistical heterogeneity (38)	Low ^d
Anxiety	N/A	SMD 0.21 higher (0.09 higher to 0.33 higher)	1316 (2 studies/ 4 sub-groups) (44, 47)	Exposed group had significantly higher means in one sub-group (47) and statistically non-significant higher values in three sub-groups (44, 47)	Low ^b

MD- mean difference; N/A- not applicable; ^{a,b,c,d} started with a low baseline rating as these were non-RCT studies and were not upgraded

Table 5: Summary of findings of the meta-analyses of categorical outcomes

Outcomes	Assumed risk ^a	Corresponding risk ^b	Relative effect	No. of participants (studies)	Quality of evidence GRADE
Anxiety	95 per 1000	186 per 1000 (176, 197)	OR=2.18 (2.03, 2.33)	40640 (39, 42)	Low ^c

^aTotal events divided by the total participants in the control group; ^bFunction of “assumed risk” and the “relative effect”; ^c started with a low baseline rating as non-RCT studies

Table 6: Sensitivity analysis with model assumptions and sub-group analysis

Sub-group	Heterogeneity	Effect measure for total participants SMD or (CI)		Sub-group analysis
		Fixed model	Random model	
Internalizing behaviour with fixed-model assumption	I ² value- 42% p=0.13	SMD=0.34 (0.21, 0.47)	SMD=0.36 (0.18, 0.53)	SMD was significantly higher in the exposed group when subgroup analysis was done with “up to 3 years”, “more than 3 years” and between “7-11 years” groups.
Externalizing behavior with fixed-model assumption	I ² value- 46% p=0.12	SMD=0.34 (0.2, 0.48)	SMD=0.35 (0.16, 0.55)	SMD was significantly higher in the exposed group when subgroup analysis was done with “up to 3 years” and between “6-11 years” groups.
Anxiety (numerical) with fixed-model assumption	I ² value- 0% p=0.58	SMD=0.21 (0.09, 0.33)	SMD=0.21 (0.09, 0.33)	Not done as the analysis included two studies despite there were 4 sub-groups
Anxiety (categorical) with fixed-model assumption	I ² value- 0% p=0.78	OR=2.18 (2.03, 2.33)	OR=2.18 (2.03, 2.33)	Not done as the analysis included two studies

alcoholism does influence the psycho-behavioral well-being of the offspring.

There are two main implications of this review as far as policy planners are concerned. Firstly, the psycho-behavioral aspects of the children of fathers with AUD or PD, need to be given adequate emphasis. Policy planners must come up with strategies in accurately detecting positive paternal alcoholics as acceptable to the specific settings. The second is that the findings can be used in targeting behaviour change of the alcoholics at appropriate settings. Health education sessions conducted for newly married couples and the ante-natal health education sessions for both parents are two such forums which can be used for this.

External factors such as technological influences and interactions of the offspring with family members may affect these associations. Hence, the exploration was limited to 22 years from 1998 to 2020. Most of the studies retained after the selection process have been conducted in Western settings. This implies that childhood mental health outcomes

are less commonly evaluated in other settings, including lower- and lower-middle income settings in which the chronic NCD burden is relatively high. The second inference may be that, even if such evaluations have been done, fewer publications are reported from such settings, suggesting that research and publications must be encouraged in these settings.

There is literature available on the mediating effects of other variables which influence these associations. Ohannessian (2015) reported that both maternal and paternal problem-drinking must be taken into context when interpreting the paternal effect on adolescent adjustment (69). It was shown that when paternal alcohol consumption was high, anxiety and depression symptomatology in children was lower when the problem drinking of the mother was low. It has also been noted that there are significant interactions of gender of the child on mental health conditions (39). These aspects must be explored more with further research.

There were several limitations of the study. No extensive effort was done in searching non-English

articles which have not been published. The English abstracts of non-English articles which were in the databases were reviewed. However, none of the non-English articles were selected (owing to the eligibility criteria) to be included in the review beyond the second round. The quality of evidence outputs of meta-analyses was graded as 'low'. This is because by default, the observational studies are initiated with a lower baseline of evidence level due to their non-randomized nature. Thirdly, a subgroup analysis on the level of alcohol intake was not done. However, this was taken into consideration in the interpretation of findings. All the exposure groups in the reported meta-analyses do fall within the category of AUD when the elements covered by these tools were evaluated (4). In the narrative synthesis, whenever it could not be judged as AUD or not, the exposure terms used by the respective studies were mentioned in the manuscript. All of the exposure groups in these exceptional studies did fall under the PD category. Furthermore, to address this issue, in the evaluation of the level of certainty of conclusions, upgrading was not done for 'dose response'.

Another limitation was the different time periods at which the outcome measurements had been done even when the tools were meant to measure similar constructs. However, similar significant associations were observed in sub-group analysis (26, 70). Even though the graphical interpretations of the Funnel plots did not point towards any major publication bias, its total absence could not be excluded. For more accurate estimation of publication bias, generally inclusion of more than 10 comparisons are recommended (71-72).

Conclusions & Recommendations

Unfavourable associations of paternal alcoholism with the selected psycho-behavioral pathologies of children were detected in the meta-analysis. These findings are found to be robust with sensitivity analysis. The narrative review further demonstrated negative implications of paternal alcoholism on five identified thematic areas. Further research must be promoted especially focusing on the mediators of these associations.

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